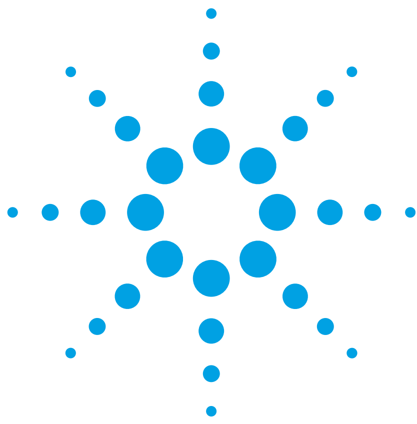
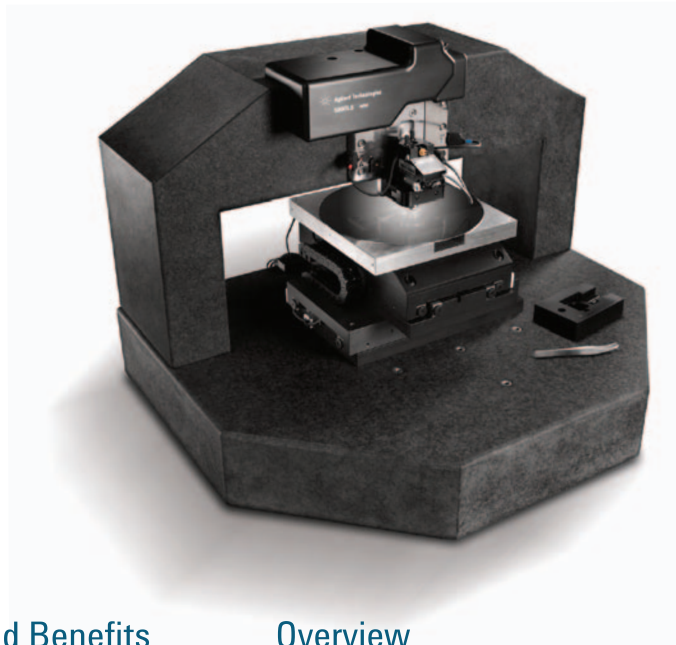


Agilent 5600LS AFM

High-Resolution Large Stage AFM Optimized for Maximum Versatility

Data Sheet



Features and Benefits

- Fully addressable and programmable 200 mm x 200 mm stage
- High resolution of a small sample area using an AFM or STM scanner
- Allows simple point-and-shoot AFM imaging based on optical view
- Low-noise AFM design (.05 nm) guarantees single atomic steps
- Motorized optical zoom and focus provide excellent ease of use
- Accurate location mapping (400 nm precision) ensures reproducibility

Applications

- Semiconductor: silicon wafers, devices
- Data storage: CD, DVD, hard drive
- Biological arrays
- Polymers, materials science

Overview

The Agilent 5600LS utilizes a fully addressable 200 mm x 200 mm stage and a new, low-noise AFM design. The programmable, motorized stage enables fast, accurate probe positioning for imaging and mapping large specimens at atomic-scale resolution using a state-of-the-art Agilent AFM. Investigators can precisely locate and identify an area of interest and, with the coordinates stored, automatically reposition the sample quickly and accurately for further study. Multiple locations can be programmed into the system.

The 5600LS is ideal for imaging large samples in air or smaller samples in air, liquid, and under temperature control. It provides researchers a perfect tool for many nanotechnology applications, including semiconductor, materials science, and life science studies. Samples up to 8" in diameter and 30 mm tall are easily accepted by the 200 mm vacuum chuck. The stage can accommodate a 300 mm wafer with repositioning.

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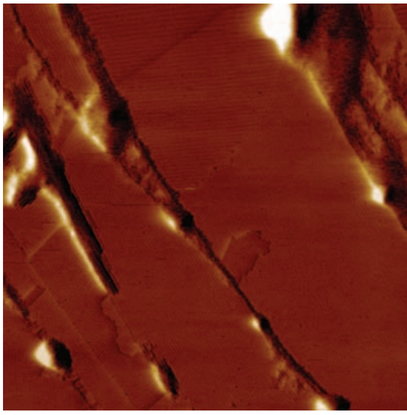
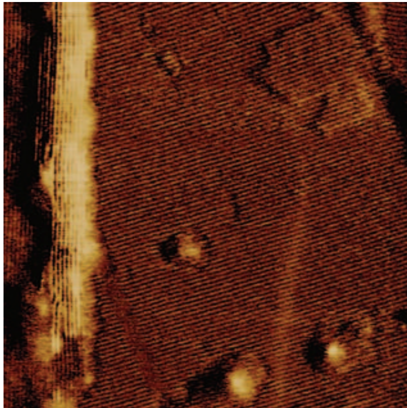
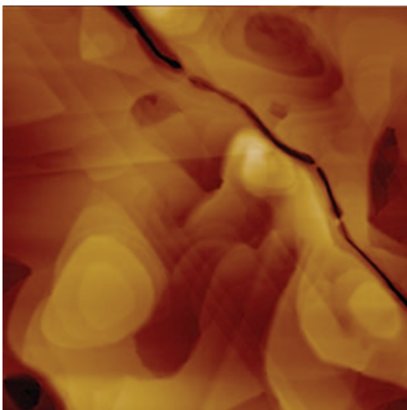




C60 phase, top image is 1200 nm and bottom image is 800 nm.



Single atomic steps on Au(111).

Innovative Design

The 5600LS combines stable, low-noise AFM imaging with high-speed, very flat, easily reproducible displacement over the entire movement range. The automated tip approach feature of the Agilent atomic force microscope minimizes damage to delicate sample structures. Motorized optical zoom and focus capabilities facilitate the automatic pre-approach, simplifying setting the initial tip-sample separation.

The 5600LS also allows researchers to perform simple, software-driven, point-and-shoot AFM imaging of an area of interest based on an optical view. AFM images can even be stitched together using Agilent's Pico Image Advanced software package (optional).

The system includes a stage, an atomic force microscope, a scanner, a controller, and a computer.

The 200 mm x 200 mm, programmable 5600LS stage has been designed specifically for use with a new, low-noise AFM. Like all Agilent atomic force microscopes, the new 5600LS AFM provides top-down scanning and exceptional precision.

Agilent AFM Modularity

Imaging Modes
The 5600LS is compatible with contact mode, acoustic AC mode, phase imaging, STM, LFM, EFM, MFM, force modulation, current sensing, and Agilent's MAC Mode III — a gentle, nondestructive technique for imaging delicate samples in air and liquid. Patented MAC Mode III provides three user-configurable lock-in amplifiers, affording researchers virtually limitless application possibilities and unprecedented speed. It also provides two expansion slots.

MAC Mode III has been designed to allow single-pass imaging concurrent with KFM/EFM. Simultaneous, high-accuracy topography and surface potential measurements are enabled by a servo-on-height cantilever approach that is not susceptible to scanner drift. KFM/EFM is especially useful for measuring dielectric films, metal surfaces, piezoelectrics, and conductor-insulator transitions.

MAC Mode III also lets researchers perform vertical or lateral modulation studies and delivers a unique plot of the oscillating amplitude vs. frequency in contact. This capability allows easy optimization of the detection sensitivity for a broad range of cantilever spring constants.

In addition to KFM/EFM and piezo force, MAC Mode III allows the use of higher resonance modes of the cantilever. Higher harmonic imaging provides contrast beyond that seen with fundamental amplitude and phase signals. This technique can be utilized to collect additional information about mechanical properties of the sample surface.

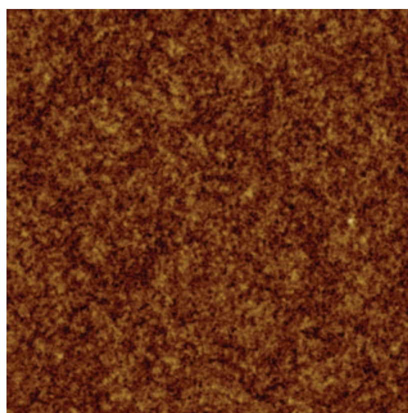
Scanners
Any of Agilent's multipurpose scanners, including open-loop, closed-loop, and STM options, can be used with the 5600LS. To provide optimized scanning for a diverse set of applications, open-loop and closed-loop multipurpose scanners are available in two scan ranges. Agilent's large scanner can scan areas up to 90 µm x 90 µm. Via an easy switch to Agilent's small scanner, which offers atomic resolution up to 9µm x 9µm, 5600LS users can image a very small sample area and see atomic steps.

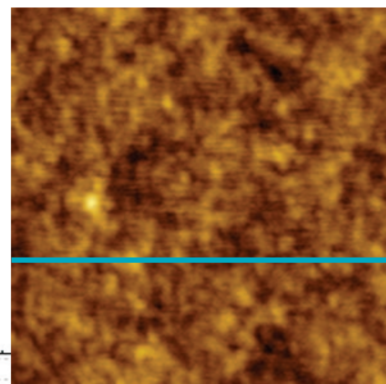
Each of these unique top-down scanners utilizes interchangeable nose cones that enable users to switch imaging modes quickly and conveniently. To deliver high-resolution imaging results, a patented pendulum scanner design eliminates artifacts in the image by keeping the relative position of the laser spot fixed in relation to the cantilever throughout the scan cycle. Furthermore, the open-top design of these scanners allows an unobstructed optical view of the cantilever and sample without sacrificing sample handling. A variety of robust, easy-to-use sample plates are offered in order to facilitate experiments in air, in liquid, or with electrochemistry.

Agilent also offers STM scanners, which deliver outstanding results on a variety of conducting materials. These low-current and ultra-low-current STM scanners provide stable imaging at pico-ampere and sub-pico-ampere currents to resolve individual atoms and molecules. STM scanners take advantage of the extreme distance sensitivity of the tunneling current between two conducting electrodes. By measuring the tunnel-current variations as a probe is scanned over a sample's surface, STM is able to deliver the highest-resolution SPM images.

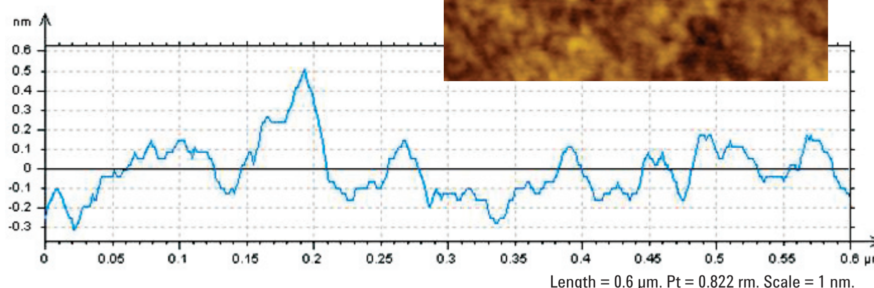
Temperature Control Options

The 5600LS is compatible with Agilent's industry-leading temperature control options. A patented thermal insulation and compensation design enables precise temperature control with excellent stability (±0.1°C or ±0.025°C; from 4°C to 250°C) for high-resolution AFM imaging.





Images of bare silicon wafer roughness.
Scan size: 3 µm (left) and 600 nm (right).



Line profile of 600 nm image of bare silicon wafer roughness.

Software

The 5600LS utilizes Agilent's PicoView 1.5 imaging and analysis software package to let users precisely program the system's stage and perform simple point-and-shoot AFM imaging of an area of interest based on an optical view.

For additional interactive post-processing capabilities, Agilent's easy-to-use Pico Image Basic imaging and analysis software package includes all of the features and functions required to build a basic surface analysis report on multi-layer measurement data that is input from the 5600LS. The document consists of a set of frames containing surfaces, profiles extracted from surfaces, the results of applying filters and other operators, analytical studies, and 2D and 3D parameters. A measurement identity card, screen notes, and illustrations can be added to each document.

Specifications

Large multi-purpose scanner	
Scanning range	90 µm x 90 µm
Z range	8 µm
Vertical noise	0.5 Å RMS
Small scanner	
Scanning range	9 µm x 9 µm
Z range	2 µm
Vertical noise	< 0.2 Å RMS

Note: Specifications shown are for open-loop operation. Closed-loop scanners are also available.

Programmable stage	
Sample size	200 mm x 200 mm
Sample thickness	30 mm
Repeatability	<500 nm accuracy and 500 nm bidirectional repeatability
Software	Programmable
Vacuum chuck	Stainless steel
Sample adaptor	Small
Optics	
Built-in video	2M pixel resolution; 2.5 µm optical resolution
Temperature variation	Does not exceed ± 2° F
Humidity variation	Does not exceed ± 20% RH
Vibration isolation	Available
Controller	
Input	Ten 16-bit channels
Drive	5 channels ± 215 V, 24-bit
Output	Four 24-bit channels, ± 10 V
Interface	USB
Power	100 – 120 V AC or 220 – 240 V AC 1A; 50 – 60 Hz
Facilities specifications	
Acoustic noise	< 75 dBc
Temperature variation	Does not exceed ± 2° F
Humidity variation	Does not exceed ± 20% RH

AFM instrumentation from Agilent Technologies

Agilent Technologies offers high-precision, modular AFM solutions for research, industry, and education. Exceptional worldwide support is provided by experienced application scientists and technical service personnel. Agilent's leading-edge R&D laboratories are dedicated to the timely introduction and optimization of innovative and easy-to-use AFM technologies.

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Printed in USA, July 14, 2008
5989-8819EN Rev A

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